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14. ABSTRACT GPS systems have become very important for space weather prediction, since many observations can be assimilated worldwide. Before doing so, it is important to verify the reliability of the measurements and their limitations. Under this grant, we used the Arecibo radar to carry out such collaborations. Using the available analysis methods, we found that E-region observations with GPS were very unreliable. The F-region profiles were much better but we did find systematic differences, particularly in the height of the maximum in electron density. These results have led to improved algorithms for profile generation using GPS.														
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Prediction of Equatorial Spread F Based on Assimilation of Daytime GPS Data

Michael C. Kelley

School of Electrical and Computer Engineering

320 Rhodes Hall, Cornell University

Ithaca, NY 14853

phone: (607) 255-7425 fax: (607) 255-6236 email: mikek@ece.cornell.edu

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LONG-TERM GOALS

Our goals were several. In the mature effort in conjunction with Jonathan Makela at the University of Illinois, we had cameras interrogating the magnetic equator from, respectively, Hawaii and Chile. Our goal was to integrate the C/NOFS data set with the images, just as we did with ROCSAT. We also developed an effort on the effect of lightning on the ionosphere. This was a team effort organized around the current ONR space science effort. Finally, we calibrated GPS density profiles with the Arecibo radar.

OBJECTIVES

First, we documented the electric fields, plasma density, and irregularities associated with Convective Equatorial Ionospheric Storms by merging the C/NOFS data set with images. Second, we took a leadership role in the ONR lightning effort and will use the general knowledge of the P.I. to provide the "big picture". Finally, we calibrated GPS profiles using the Arecibo radar.

APPROACH

The imagers are CCD and highly sensitive. We worked most closely with Jonathan Makela. On the lightning effort, the P. I. has flown 5 rockets over thunderstorms and has a deep knowledge of the issues. The Arecibo radar was well developed over 40 years and is suitable for calibrating GPS profiles.

WORK COMPLETED

Kelley, M.C., V.K. Wong, G.A. Hajj, and A.J. Mannucci, On measuring the off-equatorial conductivity before and during convective ionospheric storms, *Geophys. Res. Lett.*, 31, L17805, doi:10.1029/2004GL020423, 2004. [published, refereed]

Kelley, M.C., and M.J. Nicolls, Penetration of solar wind and magnetospheric electric fields to the inner magnetosphere, Fall AGU meeting, SA44A-02, 2006. [accepted, refereed]

Kelley, M.C., V.K. Wong, M.J. Nicolls, A. Mannucci, and J. Chau, Calibration of COSMIC ionospheric profiles using incoherent scatter radars, Fall AGU meeting, SA33B-0282, 2006. [accepted, refereed]

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Kelley, M.C., and J. Retterer, First successful prediction of a convective equatorial ionospheric storm using solar wind parameters, *Space Weather*, 6, S08003, doi:10.1029/2007SW000381, 2008. [published, refereed]

Makela, J.J., M.C. Kelley, and R.T. Tsunoda, Observations of midlatitude ionospheric instabilities generating meter-scale waves at the magnetic equator, *J. Geophys. Res.*, 114, A01307, doi:10.1029/2007JA012946, 2009. [published, refereed]

Kelley, M.C., V.K. Wong, N. Aponte, C. Coker, and A. Mannucci, Comparison of COSMIC occultation-based electron density profiles and TIP observations with Arecibo incoherent scatter radar data, *Radio Sci.*, 44, RS4011, doi:10.1029/2008RS004087, 2009. [published, refereed]

RESULTS

SEE ABOVE

IMPACT/APPLICATIONS

Prediction of CEIS has already been accomplished in extreme cases, which is an item of great concern to the military. Our GPS calibrations will help to allow prediction under less extreme conditions. Lightning detectors are crucial to the nuclear detection program at Los Alamos. But if lightning changes the ionosphere, this location method is in trouble.

TRANSITIONS

None

RELATED PROJECTS

None

REFERENCES

None

PUBLICATIONS

Kelley, M.C., V.K. Wong, G.A. Hajj, and A.J. Mannucci, On measuring the off-equatorial conductivity before and during convective ionospheric storms, *Geophys. Res. Lett.*, 31, L17805, doi:10.1029/2004GL020423, 2004. [published, refereed]

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PATENTS

HONORS/AWARDS/PRIZES

- 2003 Outstanding Alumnus of the Year: Kent State Honors College
- 2007 Editor's Citation for Excellence in Refereeing for *Geophysical Research Letters*
- 2008 Editor's Citation for Excellence in Refereeing for *Geophysical Research Letters*